8. Central Facilities Area (CFA)

The CFA provides support services for outlying operational areas. This area encompasses approximately 400 acres and includes a Health Services Laboratory (HSL), maintenance shops, vehicle fleet facilities, photographic services, a technical library, fire station, dispensary, warehouses, a batch plant with an aggregate stockpile which can produce the concrete necessary for various site construction projects, and a laundry for radioactively contaminated garments. The laundry processes about 35,000 lb/month of protective clothing and generates about 10,000 gallons/day of liquid waste. A cafeteria serves the CFA population approximately 300 meals each workday. Also at CFA are the electrical power dispatch substation, the INEL sanitary landfill, and a number of office buildings and other technical support facilities which accommodate a work force of approximately 800 people. Figure II-44 is an aerial photograph of the area. The various waste systems in the CFA are described below[3].

a. System for Venting Radioactive Airborne Wastes[a]

Radioactive materials normally are not processed or stored in the CFA. However, there is a laundry in the CFA used for the exclusive cleaning of protective clothing worn by personnel while working at the outlying nuclear facilities. These garments are frequently contaminated with low levels of radioactive material. The laundry receives this clothing in polyvinyl alcohol bags and the entire bag (water soluble) is placed within a washing unit to prevent any spread of radioactive material within the building proper. After washing, the clothing is dried, monitored, folded, and returned to the various INEL facilities. During the drying process, off-gas from the dryer is exhausted to the atmoshere through a roof ventilator. This ventilator contains a screen to collect any lint that is entrained within the off-gas stream. This lint frequently is contaminated with radioactive materials (gamma intensities up to 10 mR/hr). Some lint occasionlly falls upon the roof of the building, and in some instances on the ground near the building. The area around the building is surveyed frequently, and in no instance has any radioactivity been detected more than about 100 feet from the building. Anytime that detectable quantities of radioactive lint are found to be escaping the screen, the immediate area is surveyed and decontaminated. This is a continuous surveillance problem, however, recent installation of a smaller screen size and the use of furnace-type filters have provided a temporary solution to the problem. Nevertheless, consideration is being given to installing a water bath or similar system to provide better controls on the contaminants being exhausted in this system. A new laundry is planned and has been submitted in the 1978 congressional budget. When approved and constructed the new laundry will have effluent controls utilizing state-of-the-art technologies to prevent radiological releases. There are no other failities at the CFA that release radioactive materials to the atmosphere by airborne waste systems.

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[a] See Appendix E, Section 4.B. for additional details on the planned new laundry facility.

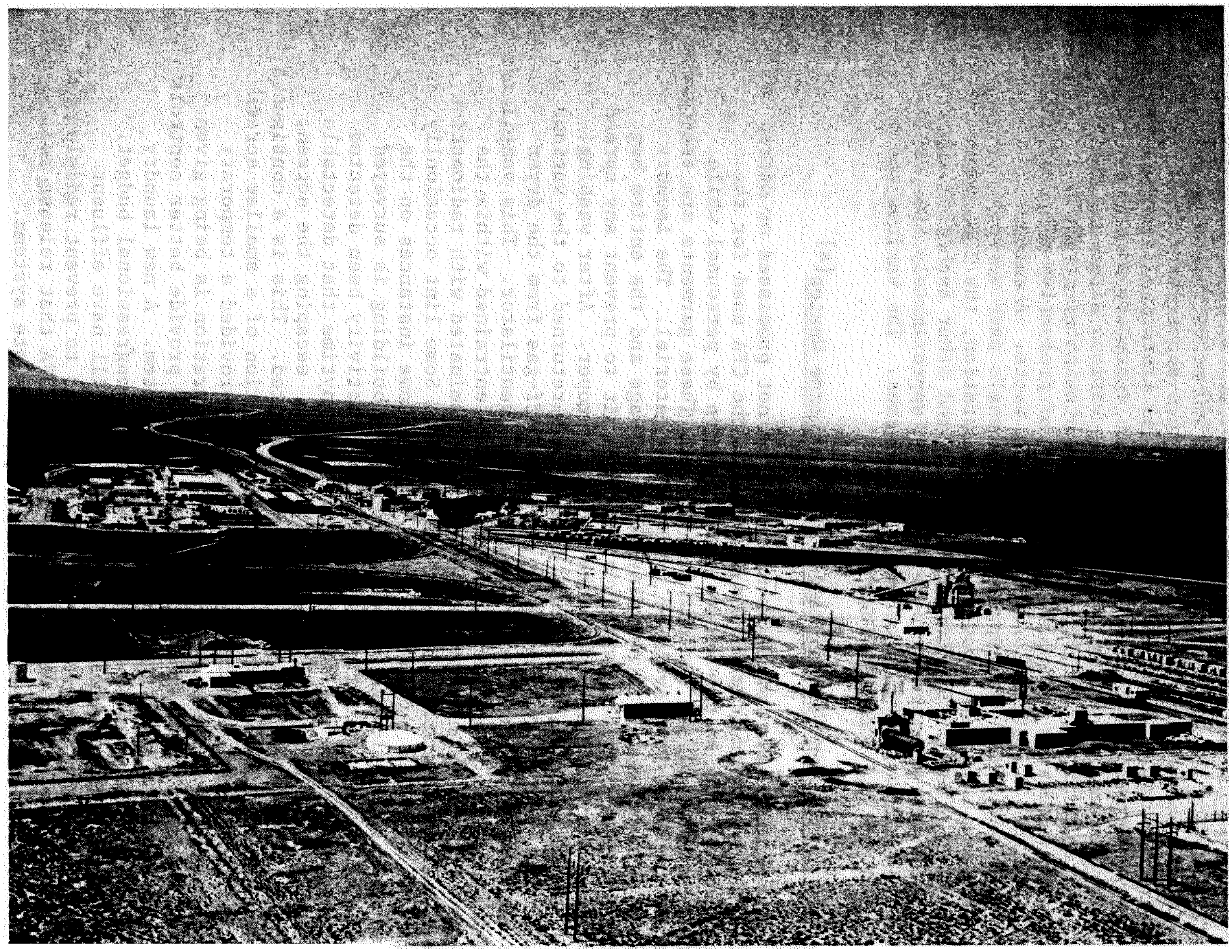

Figure II-44. Aerial View of CFA.

b. System for Venting Nonradioactive Airborne Wastes

The primary airborne wastes produced at CFA are nonradioactive and are generated by the furnaces used for steam generation, water, and space heating. For the larger buildings, nine boilers are required. With the exception of the laundry boiler, these are automatic units, operating unattended, which burn either No. 2 or No. 5 fuel oil. The locations and capacities are listed in Table II-51.

TABLE II-51

CFA BOILER CAPACITIES

Location	Heat Input (millions of Btu/hr)
Cafeteria	3.0
Cafeteria	2.5
Vehicle service terminal	3.5
Vehicle service terminal	3.5
Technical Center	5.0
Technical Center	12.0
Material warehouse	5.5
Material warehouse	3.5

In addition, a number of smaller office areas are heated by domestic furnaces and boilers. Consumption of fuel oil at the CFA during 1974 amounted to 407,000 gallons of No. 5 oil and 183,000 gallons of No. 2 oil, producing about 105,000 lb of sulfur dioxide and 17,000 lb of particulate material.

The above boilers, with capacities over 1 million Btu/hr, are sampled at least every third year. Sampling is done by an industrial hygiene group of an INEL contractor. Analyses are made to determine flue gas composition, particulate mass rate discharge and size distribution, excess air, and firing rate during sampling as percent of design.

c. System for Disposal of Radioactive and Nonradioactive Liquid Wastes

(1) Water and Sewage Treatment

The CFA is supplied with water from two wells with a total capacity of 2,000 gallons/min. A chlorinator adds gaseous chlorine to the raw water pumped from the wells to purify the entire water system. The water is distributed to areas within the CFA. With the exception of that used for summer irrigation, this water eventually is discharged to the CFA sanitary waste system. At the CFA there is no separation of radioactive and nonradioactive liquid waste systems. The only significant source of radioactive material that could be introduced into the liquid waste is the laundry. However, a flow drain from a materials testing laboratory is terminated in a nearby pit. This drainage can contain small quantities of radioactive contamination.

Liquid radioactive wastes from the garment laundry, as well as CFA sanitary wastes, receive secondary treatment at the CFA sewage treatment plant. This plant is located adjacent to the laundry in the northeast part of the CFA. Both effluents flow by gravity to the treatment plant where they are metered separately. The mean flow rate is about 40 million gallons/yr, of which about 4 million gallons is effluent from the laundry. Raw and treated sewage streams are sampled continuously (but not proportionally) for radioactivity, and samples are analyzed weekly for alpha, beta, and gamma activity. Results of the radioactivity analyses are summarized and reported monthly. Samples are taken weekly for BOD analysis. Daily determinations are made for settleable solids, pH, and free chlorine residue.

The treatment plant consists of a bar screen, primary clarifier, trickling filter, secondary clarifier, chlorination basin, and seepage bed. A simplified flow chart for the plant is given in Figure II-45.

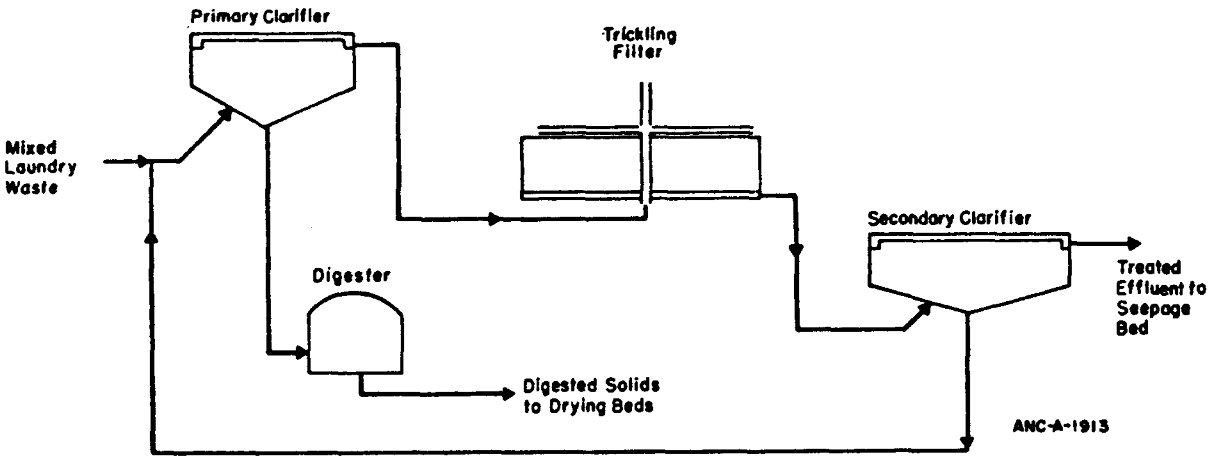

Figure II-45. CFA Waste Treatment Facilities.

As shown on this flow chart, settleable solids are separated in the primary clarifier and pumped to a steam heated anaerobic digester where they are stabilized. Overflow from the primary clarifier flows by gravity to a trickling filter, and then to a secondary clarifier. The overflow from the secondary clarifier is chlorinated and flows to a lift station where it is pumped to a subsurface drain field.

A significant amount of radioactivity in the incoming liquid ultimately ends up in the digested sludge. For this reason the dried sludge is packaged and disposed of at the INEL Radioactive Waste Management Complex.

Average operating characteristics for the treatment system are as follows:

(1)	Laundry washed	35,500 lb/mo
(2)	Laundry liquid effluent	342,000 gal/mo
(3)	Domestic sewage effluent	3,691,000 gal/mo
(4)	Average alpha activity of effluent	1.7×10^{-8} μCi/ml
(5)	Average beta-gamma activity of effluent	9.0×10^{-7} μCi/ml
(6)	Average total effluent activity	0.014 Ci/mo
(7)	Dried sludge activity	0.0025 μCi/g
(8)	Dried sludge weight	32,400 lb/yr
(9)	Total sludge activity	0.05 Ci/yr

(2) Waste Oil

Approximately 22,000 gallons of waste oil are generated annually through the maintenance of INEL buses, automobiles, and other vehicles and engines. This oil formerly was disposed of by ground seepage from trenches excavated in the desert gravel; however, during 1970 this waste oil was applied in mild weather for dust suppression purposes on INEL dirt roads. Additional efforts are being made to find equipment for reprocessing the oil so that it can be blended with No. 6 oil for use as boiler fuel.

(3) Waste Chemicals

Chemical usage locations and typical annual amounts are listed below:

(1)	Cafeteria - powdered soap and water conditioners	3,600 lb
(2)	Vehicle maintenance terminal - vehicle washing soap	437 lb
(3)	General custodial cleaning products	3,747 lb
(4)	Radioactive garment laundry - soap	10,585 lb
(5)	Sour, bluing, and bleach	1,385 lb

All of the above solvents find their way to the CFA sewage treatment plant. Other chemicals, such as boiler feedwater additives, also flow to the sewage treatment plant from boiler blowdown (225 gallons/yr). Various water softeners, mostly for boiler feed supply, are located at the CFA. Regeneration of these softeners requires approximately 48,000 lb/yr of salt.

d. Systems for Disposal of Radioactive and Nonradioactive Solid Wastes

Construction materials which have been irradiated are tested for mechanical properties at a CFA testing laboratory. These materials contain activation products. Small specimens of irradiated fuel also undergo microprobe analysis at this facility. The activity of each specimen is estimated to average about 5 Ci.

All solid radioactive wastes generated at the CFA are packaged and shipped to the INEL Radioactive Waste Management Complex for disposal. Most of the waste is collected in 12-ft^3-capacity cardboard boxes and transported in metal dumpsters. Approximately 14 boxes (168 ft^3) are generated each month. Most of the waste consists of contaminated rags and paper used in the laundry process. The laundry also segregates and disposes of clothing received from the various station areas which is too radioactive for continued use. Minimal amounts of radioactive solid wastes are also generated from experiments at the Health Services Laboratory and the Materials Testing Laboratory, and also from special CFA maintenance operations. Finally, digested sludge from the CFA sewage treatment plant is also classified as radioactive solid waste. During 1974, the approximate volume and activity of the wastes from CFA were about 7,630 ft^3 and 1.6 Ci, respectively.

About 5,000 yd^3 of nonradioactive trash from CFA dumpsters, 400 yd^3 of nonradioactive garbage from the cafeteria, and 150 yd^3 of nonradioactive concrete rubble and scrap metal were sent to the sanitary landfill in 1974.

9. INEL Solid Radioactive Waste Management Areas

There are several areas at the INEL dedicated to the storage or disposal (by burial) of solid radioactive waste material[3]. These areas are:

(a) INEL Radioactive Waste Management Complex and associated Transuranic Storage Area (TSA)
(b) SL-1 Burial Ground
(c) Radioactive Scrap and Waste Facility at ANL-W
(d) Calcined Solids Storage Facilities at ICPP for storage of solid calciner product.

These disposal/storage areas are described in the following paragraphs.

a. Radioactive Waste Management Complex (RWMC)

The RWMC was established in the southwest corner of the INEL in 1952 to accommodate the radioactive wastes generated by laboratory operations. It was conveniently located adjacent to the EBR-I, the first reactor operated at the INEL. The first trench was opened July 8, 1952. In addition to wastes generated at the INEL, the RWMC also has received wastes from the ERDA's Rocky Flats Plant since 1954. Most of these Rocky Flats wastes are contaminated with uranic and transuranic nuclides. Lesser quantitites of waste also have been received over the years from other ERDA associated facilities.

The original area involved 13 acres. This was expanded to 88 acres in 1957 and enclosed a pit previously used for disposal of laboratory acid. The pit was later abandoned. [A summary of the RWMC environmental monitoring program is presented in Section II.C.12].

Figure II-46 is an aerial photograph of the area showing the RWMC. The RWMC consists of the Subsurface Disposal Area (SDA), the Transuranic Disposal Area (TDA), the Transuranic Storage Area (TSA), and a compactor and equipment building.

The Subsurface Disposal Area is a fenced 88 acre plot of land used for near surface (3 to 12 feet deep) burial of nontransuranic solid wastes generated at INEL facilities. These wastes are deposited in trenches or pits and covered with soil and this procedure is considered permanent disposal.

The Transuranic Disposal Area is an asphalt pad within the SDA that is used for permanent disposal of uranic and transuranic wastes containing less than ten nanocuries (nCi) of transuranic activity per gram of waste. The waste containers are stacked on the asphalt pad and then covered with earth. These wastes are considered permanently disposed of.

The Transuranic Storage Area consists of asphalt pads adjacent to the SDA used for storage of transuranic wastes contining more than 10 nCi of transuranic activity per gram of waste. The TSA is used for interim storage. The waste containers are designed for 20-year integrity. The containers are stacked on the pad, covered

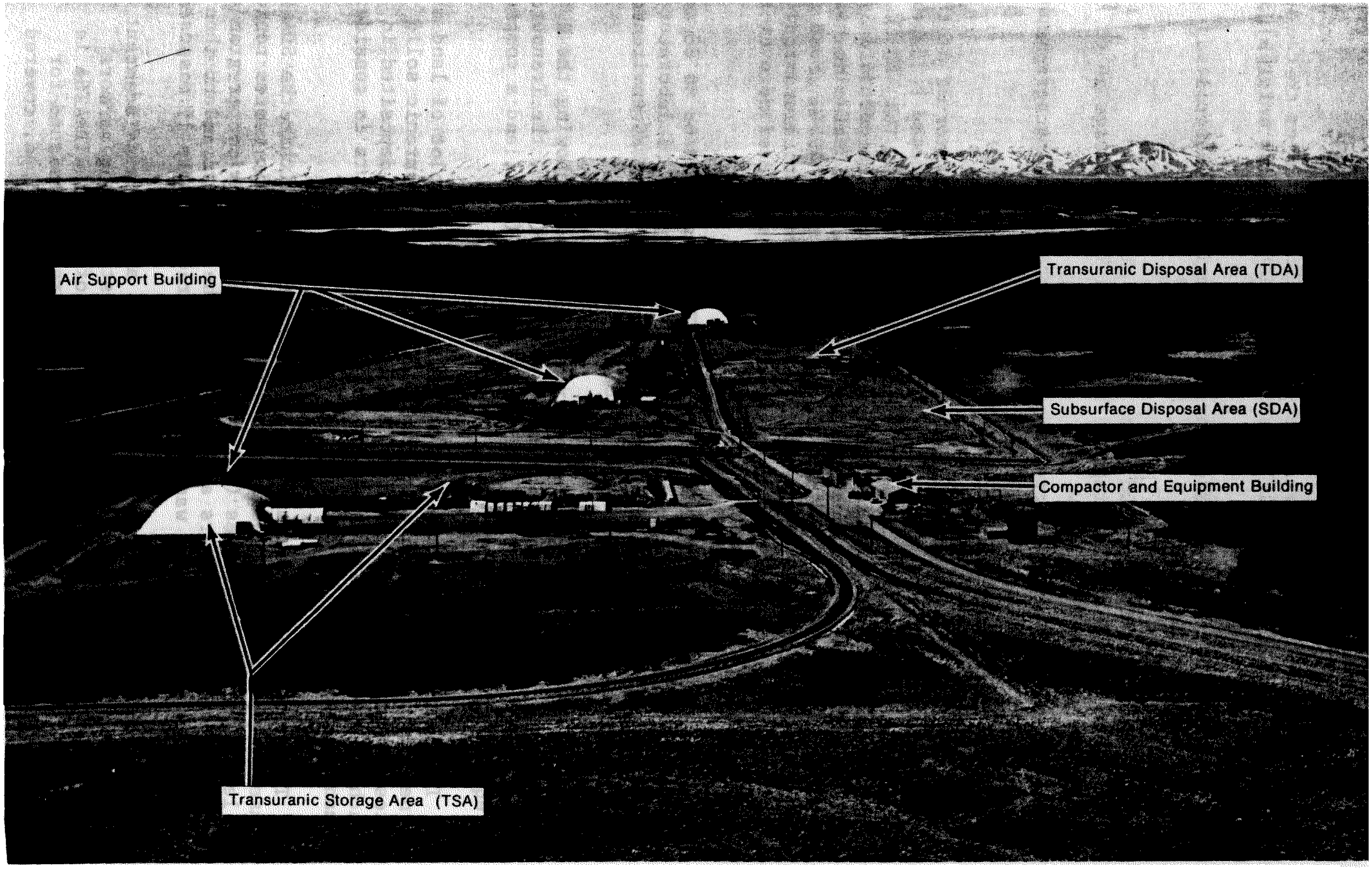

Figure II-46. Aerial View of the INEL Radioactive Waste Management Complex.

with plywood and then nylon reinforced polyvinyl and a final covering of 2 to 3 feet of earth. This waste will be removed to a federal repository when one becomes available, sometime during the early 1980s.

The compactor and equipment building houses a waste compactor (used for compacting low-level INEL generated nontransuranic wastes), a health physics office, and provides space for miscellaneous equipment.

The RWMC is enclosed by fences and surrounded by dikes and drainage channels. The details of the various facilities are described below.

(1) Subsurface Disposal Area (SDA)

The SDA is a fened 88 acre alot of land used for the permanent disposal (by burial) of nontransuranic solid wastes. The wastes are deposited in excavated trenches or pits and then covered with soil. The trenches and pits are described below.

(a) Trenches

These trenches average 900 ft long, 6 ft wide, and 12 ft deep, depending upon the depth of soil to the basalt surface. They are used for the disposal of compactible solid radioactive waste such as paper, rags etc , and also for noncompactible solid wastes originating at the INEL.

Most of onsite solid low-level radioactive waste, until January 1974, was received at the RWMC in boxes sealed with tape. These boxes were of cardboard construction and measure 2 x 2 x 3 ft (12 ft^3). They were dumped into a trench; when the trench was full of waste, a heavy steel weight was dropped by a crane onto the waste, compacting it to approximately half its volume. More waste was dumped and the compaction process was repeated. A final addition of waste was then added and compacted, and a 3-ft-deep soil cover was applied. Since 1971, compactible waste generated at the NRF has been compacted and sent to the RWMC in bales. Since January 1974, all other compactible waste received at the RWMC is being compacted. Use of a bale-type unit that utilizes a 50-ton hydraulic press to achieve a 10-to-1 reduction in waste volume has been implemented. The 600 lb bales are placed in specially designed fiberboard boxes with plastic liners that provide a protective container and aid stacking in the pits or trenches. Presently, most of the onsite wastes are transported to the RWMC in plastic bags to accommodate the new compaction operation. Larger noncompactible wastes arrive in wooden boxes and are stacked in the trenches along with the compacted bales.

Wastes with high gamma radiation levels are handled remotely, utilizing special shielded containers and boom cranes. When the trenches are full they are covered with a minimum of 3 ft of soil. The locations of all filled trenches are identified by concrete monuments placed on each end of the trench. The monument also contains a brass plate with the opening and closing dates of the trench stamped thereon.

(b) Pits

These pits are an average of 12 ft deep, 100 ft wide, and of variable length. Bulky, irregular sized wastes such as tanks, drums, piping, etc., are transported to a pit in trucks, deposited therein, and covered with soil when enough area has been filled to allow earthmoving equipment to travel across the face of the pit. Solid waste dumped in trenches or pits is covered by the end of each week to minimize the chance of waste and contamination leaving those areas. The corners of the pits are marked with monuments in the same manner as the trenches. Until November 1970 all offsite wastes were buried in this type of excavation.

(2) Transuranic Disposal Area (TDA)

The TDA consists of an asphalt pad within the SDA Complex. The pads are at ground level and has a surface area of about 20,000 ft^2, enclosed on three sides by an earth berm. The 3-in. asphalt surface rests upon a 4-in. gravel base and is sloped toward the center and the open end for drainage of moisture. One such pad is in use at the RWMC. Drums and crates of uranic and transuranic waste containing less than 10 nCi (1 x 10^{-8} Ci) of transuranic activity per gram of waste, are stacked on the pad in a horizontal geometric configuration to a height of about 18 ft. Once a section of the pad is filled with containers, earth is moved over the top and sides of the stack to provide a moisture barrier over the waste. This disposal concept allows for greater container integrity, an all-weather working surface, and maximum utilization of surface area within the RWMC.

(3) Transuranic Storage Area (TSA)

The construction of the TSA is similar to that of the TDA and affords the same advantages. Transuranic wastes are stored on an interim basis on this pad which measures 150 x 730 ft. The waste is packaged in containers designed for 20-year integrity. The bulk of the wastes stored on the TSA pad arrives at the INEL by rail from the Rocky Flats Plant. Some uranium-233 wastes from Bettis Atomic Power Laboratory (BAPL), which is associated with the ERDA's Pittsburgh Naval Reactor Office, and from other potential sources such as the ERDA's Mound Laboratory at Miamisburg, Ohio, also are received -- along with any INEL generated transuranic wastes. The containers must meet 20-year integrity requirements for storage on the TSA pad, along with other safety and administrative imposed requirements. Shippers must color code their own drums to aid in identification and retrieval operations and to signify contents. Figure II-47 is a photograph of the TSA.

The TSA is filled in 80- x 150-ft sections called "cells." The drums are stacked five high in a close-pitched triangular array with a layer of fire retardant plywood and plastic sheeting separating each level. The sides of the cells are lined with 4- x 4- x 7-ft fiberglass-coated wooden boxes that contain waste too bulky for the drums. The boxes define the cells and provide end support for the drum array. Each cell in the 730-ft length of the pad is separated by a 3-ft-thick soil firewall as the cell is completed. The entire array is covered with fire-retardant plywood and nylon reinforced polyvinyl before the final 2- to 3-ft-thick soil cover is placed. The soil for this purpose is obtained from nearby soil borrow areas.

Before any shipment is approved for receipt or storage on the TSA pad, the necessary reviews and/or analyses are performed to ensure the safe handling of that shipment. Criticality safety of storing

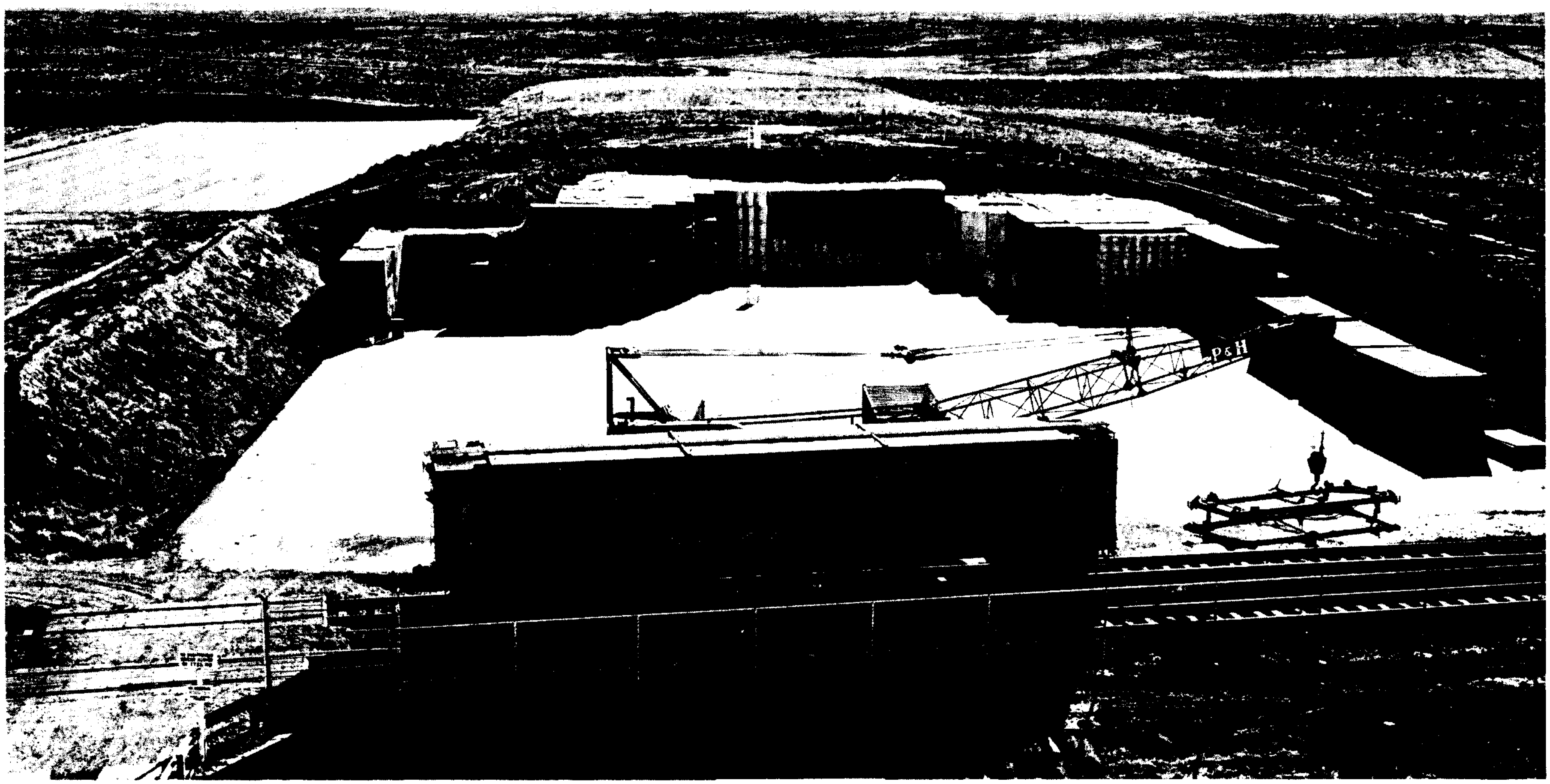

Figure II-47. End View of the TSA Showing Stored Waste Containers.

large accumulations of these wastes is assured by control over contents, container specifications, and nondestructive assay. Radiation from the transuranic waste is primarily nonpenetrating, and thus does not present a direct radiation hazard to personnel. There is always a possibility of airborne releases whenever waste is being handled. Monitoring for contamination is continuous during handling operations to detect whether any of the hazardous materials are escaping from their containers. Air monitors are located upwind and downwind from operation areas whenever weather or other conditions warrant. The only effluents resulting from waste handling operations are those occurring from natural phenomena, such as runoff of precipitation and windborne particulate wastes.

Four deep wells (approximately 700 ft) are located near the RWMC for routine water sampling. One 250-ft hole is also located within the Subsurface Disposal Area (SDA). Twenty-seven additional shallow probes within the SDA extending to bedrock level are available to sample percolated water and to check for contamination migration in the subsoil. Water samples are collected in the spring and after storms and analyzed for radioactivity. A water sampling station is located at the low end of the TSA pad to collect runoff rainwater. Each of the cells within the TSA pad has moisture sampling pipes. Four of the cells have 3-in. diameter vertical pipes that can be opened for sampling the humidity and temperature of the cell atmosphere. Additional details of the RWMC environmental monitoring program are described in Section II.C.12.

(4) Waste Data Information

Solid radioactive waste enters the SDA and TSA in the following containers:

(a) Special shielded cask inserts (SDA)

(b) 55- and 30-gallon steel drums mostly from offsite shippers (TSA)

(c) 4- x 4- x 7-ft wooden boxes (TSA)

(d) Compacted 14-ft^3 bales (SDA)

(e) Fiber barrels (SDA)

(f) Other special containers, such as the 6-mil yellow plastic bags used for compactible waste (SDA).

The shipper of radioactive wastes completes special forms to accompany each shipment. These forms contain information on waste volume, nuclide content, and activity. These data are used as input to the INEL monthly computerized radioactive waste reporting system, the WMIS. Prior to submission of these data to the computer, the dispositions of the wastes (including storage/disposal sites) are recorded on the forms.

Waste currently placed in the SDA is considered disposed of, whereas that stacked in the TSA is considered stored. From 1954 through November 1970, transuranic wastes containing approximately 366 kilograms (807 lbs.) of plutonium contaminated waste were deposited in the SDA. Plutonium-239 comprised about 93% of this activity with lesser amounts of plutonium-238, -240, -241, and -242. ERDA currently is conducting programs at the INEL to determine the feasibility, costs, and radiological impacts (occupational and environmental) attendant to the exhumation of transuranic wastes buried at the SDA prior to November 1970. This effort includes actual exhumation of a portion of the buried TRU waste. An air support building is being used to avoid potential contamination of the environment during the retrieval program. The air support building is positioned over the work site; the soil overburden is removed, the disposed 55-gallon drums are recovered and then repackaged in 83-gallon steel drums or wood and fiberglass boxes. The retrieval program is under continuous Health Physics monitoring and surveillance to identify potential sources of radioactive contamination. After the drums have been removed from the area under the air support building, the excavated area is backfilled with soil, smoothed, and graded to comply with drainage requirements. The air support building then is moved to another location and the work sequence repeated. The repackaged drums from this retrieval program are being stored on the TSA. Ultimate disposal will be at a Federal repository.

A summary of solid radioactive wastes stored or disposed of at the TSA and SDA during 1974 is given in Table II-52. Table II-53

TABLE II-52

SOLID RADIOACTIVE WASTE STORED OR DISPOSED OF AT INEL SDA OR TSA DURING 1974

Originating Facility	Volume (10^3 ft^3)	Curies
	Disposed-of Wastes at SDA	
ANL	9.5	708
ARA	0.8	1
CFA	7.7	16
CPP	34	5,739
NRF	9.7	5,822
SPERT	<1	<1
TAN	7.1	6,736
TRA	7.6	736
Rocky Flats (TDA)	53.9	10
Total	130	19,770
	Stored Waste at TSA	
TSA	146	23,530

TABLE II-53

SOLID RADIONUCLIDES DISPOSED OF AT INEL SDA DURING 1974

Nuclide	Curies
Antimony-125	107
Cerium-141	2
Cerium-144	805
Cesium-134	66
Cesium-137	1,424
Chromium-51	82
Cobalt-58	2
Cobalt-60	7,662
Europium-154	42
Europium-155	24
Iron-59	1,440
Manganese-54	72
Mixed activation products	92
Mixed fission products	761
Nickel-59	3,200
Plutonium-238	<1
Plutonium-239	<1
Plutonium-240	<1
Plutonium-241	5
Plutonium-242	<1
Radium-226	1
Rabidium-86	63
Ruthenium-106	338
Strontium-90	1,579
Thorium-232	<1
Uranium-233	<1
Uranium-235	<1
Uranium-238	5
Unidentified alpha	<1
Unidentified beta and gamma	29
Zinc-65	361
Zirconium/niobium-95	154
Total	18,316

is a list of the radioactive nuclides disposed of at the INEL in 1974. The radioactive nuclides stored at the TSA during 1974 are listed in Table II-54. Table II-55 shows a 21-year summary of wastes disposed of at the SDA or stored at the TSA.

Figure II-48 shows the distribution of solid radioactive wastes handled by volume at the INEL from 1961 through 1974. Figure II-49 shows graphically the total volume and activity of solid wastes handled from 1952 through 1974.

TABLE II-54

TSA NUCLIDE SUMMARY FOR 1974

Nuclide	Curies	Grams
Americium-241	4,453	1,374
Mixed fission products	22	--
Plutonium-238	58	3
Plutonium-239	1,921	31,290
Plutonium-240	472	1,974
Plutonium-241	16,390	146
Plutonium-242	<1	10
Uranium-232	3	0.2
Uranium-233	204	21,500
Uranium-235	<1	39
Uranium-238	<1	49
Total	23,530	56,385

TABLE II-55

SOLID RADIOACTIVE WASTE DISPOSED OF OR STORED AT RWMC 1952-1974

	Disposed of at SDA or TDA		Stored at TSA	
Year (s)	Volume (10^3 ft^3)	Curies	Volume (10^3 ft^3)	Curies
1952-1964	2,180	771,300		
1965	266	702,900		
1966	335	924,300		
1967	341	877,800		
1968	485	301,500		
1969	406	971,000		
1970	442	504,400	50	4,225
1971	142	350,900	251	12,670
1972	125	214,700	209	28,500
1973	137	339,800	208	24,600
1974	130	19,700	146	23,530
Total	4,990	5,978,000	864	93,525

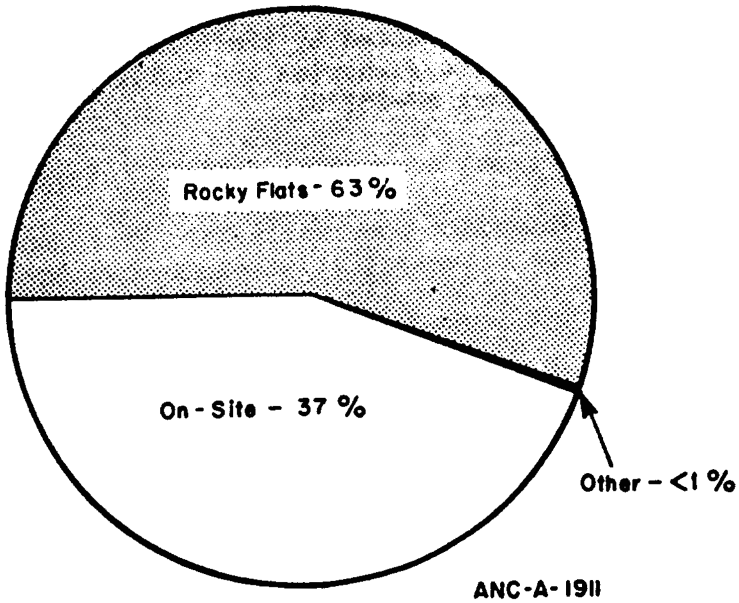

Figure II-48. Distribution of Solid Radioactive Wastes Handled by Volume at the INEL (1961-1974).

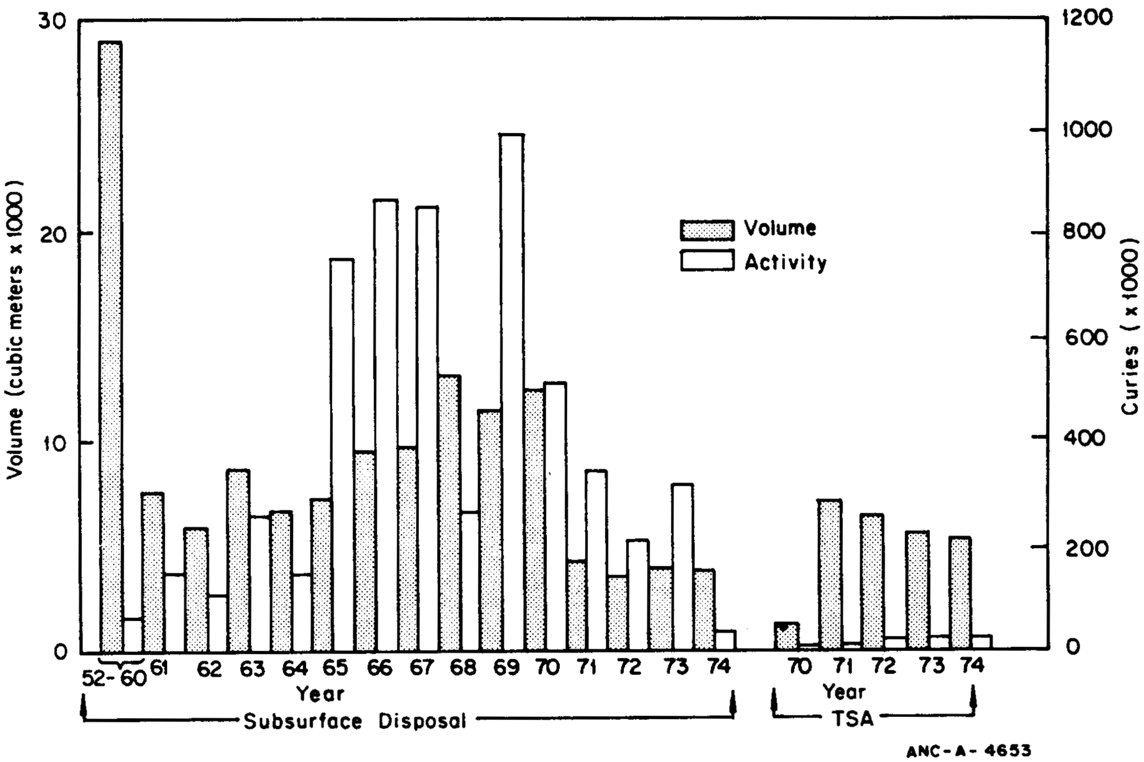

Figure II-49. Radioactive Solid Wastes Handled at INEL SDA and TSA by year.

b. <u>Stationary Low Power Test Reactor (SL-1) Burial Ground</u>

The SL-1 Burial Ground is located about 1,600 ft east of the old SL-1 area (ARA-II), which is 7 miles east of CFA as shown in Figure II-2. The total area within the exclusion fence around the disposal area is about 4.1 acres. A plot plan of the SL-1 Burial Ground is shown in Figure II-50. The waste material was hauled from SL-1 in trucks and dumped into (1) a trench 6 ft wide, 10 ft deep, and 495 ft long; (2) one pit, 12 ft wide, 10 ft deep, and 495 ft

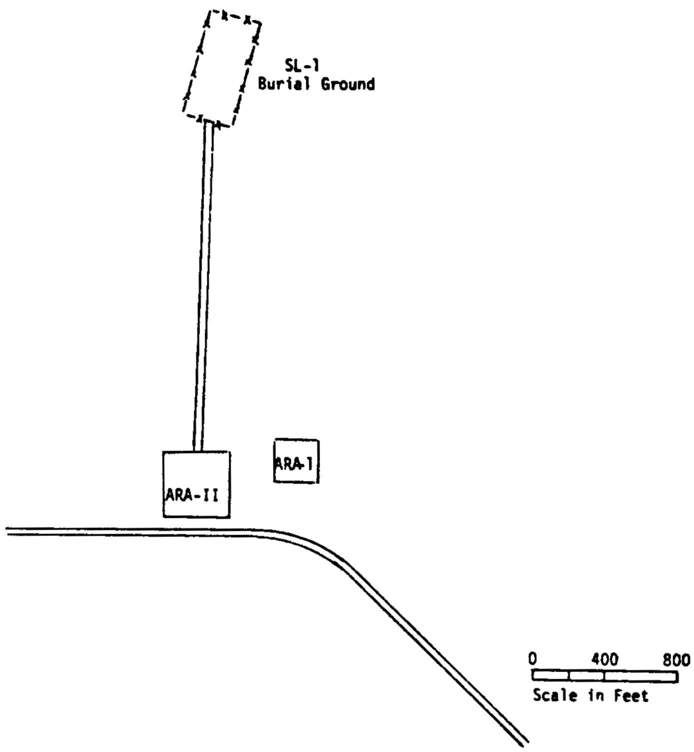

Figure II-50. Plot Plan of SL-1 Burial Ground.

long; and (3) one pit 20 ft side, 10 ft deep, and 400 ft long. Approximately 26,500 ft^3 of contaminated dirt and gravel from the demolition area were buried.

The SL-1 experienced an accidental nuclear excursion (described in Section II.C.11) on January 3, 1961, which destroyed the reactor and contaminated the reactor building. Between May 23, 1961, and July 27, 1962, the reactor and reactor building were dismantled. The reactor pressure vessel and core were taken to the TAN hot shop to be dismantled and examined; however, most of the dismantled building, contaminated equipment, and the decontamination waste was interred directly in a burial ground established a short distance from the facility.

Only about 5% of the fission products from the excursion (about 130 MW-sec) escaped from the pressure vessel during the accident. The uranium was reclaimed except for a little less than 1 kg. Measurements of waste going into the SL-1 Burial Ground indicate that about 600 Ci were interred owing to the accident. Since the SL-1 disposal area was only for waste from the one incident, this amount constitutes the total material buried in the area. No wastes have been buried there since 1962. The SL-1 Burial Ground is routinely monitored and inspected to ensure that no problems associated with these wastes arise.

c. <u>ICPP Calcined Solid Storage Facilities</u>

The ICPP calciner storage bins area is considered a solid waste management location. These underground engineered receiving bins store the solid calciner product. These storage bins were first put into service in 1963, and through 1974 approximately 53 million Ci of radioactivity representing 43,190 ft^3 of total volume have been stored within them. Almost 100% of this radioactivity is composed of strontium-90 and cesium-137. The details of these storage bins are given in Section II.A.3.

d. <u>ANL Radioactive Scrap and Waste Facility (RSWF)</u>

The ANL-W Radioactive Scrap and Waste Facility[46], (shown in Figure II-51), used for storage of solid wastes and scrap only, is a controlled access, fenced, 4-acre area located about one-half mile north of the EBR-II area. The area was selected based on drainage considerations, and built up by banking the earth to a level several feet above the original land surface to eliminate chance of flooding by surface runoff. The area hydrology is such that the surface of much of the area is covered by waterborne and windborne top soil under which there is a depth of gravel ranging is size from fine sand to 3-in. diameter gravel. Lava rock extends below this gravel layer and downward ranging at least to the water table, which is at approximately 600 feet. Test borings were made within the storage facility area indicating that the depth of regolith varies from 11.8 feet to 23.5 feet. Three test wells located within the area, at depths of 13, 17, and 30 feet, have not shown any water; therefore, no leakage or migration of radioactive material has been detected by this method.

The storage site utilizes storage holes with steel liners. The liners are welded closed at the bottom end, and are provided with a top closure plate which is welded on after the material had been deposited. Only solid material is stored at the RSWF. The material is canned and placed in the liners. The facility was designed for 27 rows on 12-ft centers with approximately 40 holes per row on 6-ft centers. There are no future plans to expand this facility.

Material in the RSWF may be divided into two basic categories: scrap and waste. Since scrap is defined as having potentially recoverable material and not as waste material, it is not considered further in this statement. The waste material can be broken down into transuranic (TRU), nontransuranic (non-TRU), and material containing sodium. Tables II-56 and II-57 present information on material stored in the RSWF through December 31, 1974.

The facility was first used in 1965 and through 1974 had received 2000 ft^3 of waste, all of which originated at ANL. The radioactivity consists mainly of activation and fission products with smaller quantities of transuranic wastes. Activation products include manganese-54, cobalt-58, cobalt-60, chromium-51, etc. Fission products include

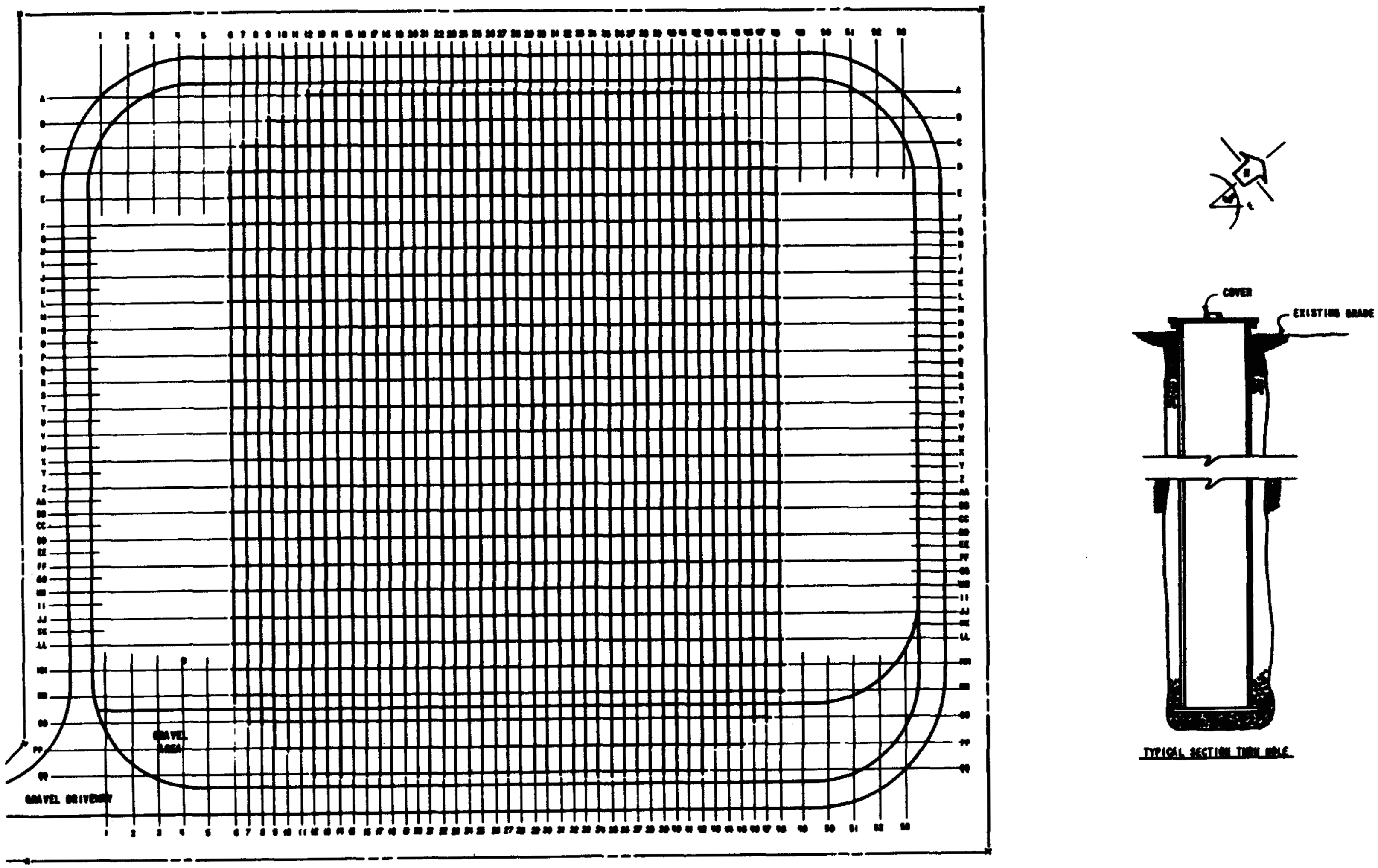

Figure II-51. ANL-W Radioactive Scrap and Waste Facility.

TABLE II-56

NONTRANSURANIC WASTE AS OF DECEMBER 31, 1974

Material	Number of Liners	Total Volume, ft^3	Total Sodium, gm	Curies Stored
Noncombustible No sodium Primarily fission prod.	118	527	--	1,721,667
Noncombustible No sodium Primarily activation prod.	110	498.5	--	2,951,861
Noncombustible Sodium Primarily fission prod.	79	355.5	4,844	1,335,484
Noncombustible Sodium Primarily fission prod.	9	38	2,248	76,529
Mixed No sodium Primarily fission prod.	14	56	--	116,226
Mixed No sodium Primarily activation prod.	48	216.5	--	1,261,965
Mixed Sodium Primarily fission prod.	33	149	1,617	354,901
Mixed Sodium Primarily activation prod.	2	9.5	72	5,827
Totals:	413	1,850	8,781	7,824,460

TABLE II-57

TRANSURANIC WASTE AS OF DECEMBER 31, 1974

Material	Number of Liners	Total Volume, ft^3	Total Plutonium, gm	Total Sodium gm	Curies Stored
Noncombustible No sodium Primarily fission prod.	1	4.5	0.4	--	20
Noncombustible No sodium Primarily activation prod.	None				
Noncombustible Sodium Primarily fission prod.	59	261.5	1,294.83	∿75,513	1,538,350
Noncombustible Sodium Primarily activation prod.	1	4.5	8.2	∿666	32,000
Mixed No sodium Primarily fission prod.	None				
Mixed No sodium Primarily activation prod.	None				
Mixed Sodium Primarily fission prod.	None				
Mixed Sodium Primarily activation prod.	1	4.5	40.73	Yes	4,300
Totals:	62	275.0	1,344.16	76,179	1,574,670

the long lived strontium-90, cerium-144, ruthenium-103, and cesium-137. Through December 1974, approximately 9.4 million curies of waste had been stored at the RSWF.

The stored material consists primarily of waste metal from fuel handling and refabrication operations. The waste is remotely loaded into a steel waste can which is then sealed and placed in a top-loading, bottom-unloading waste handling cask. The cask provides adequate shielding for personnel protection and when loaded is removed from the loading cell and transported on a special truck to the storage site. The special truck allows the cask to be positioned directly over an empty hole for easy placement of the steel waste can.

The storage liners (complete with contained waste) are designed to be retrievable. A detailed surface and structural examination of an empty underground storage tube was conducted after 5-1/2 yr of use. The examination included a visual observation of the surface, microstructural, and micrometer measurements. The storage container received only slight corrosion on the outer surfaces. The small deviations observed from the "as-specified" wall thickness of the container indicate that the integrity of the container is well preserved and prolonged life (greater than 20 yr) can be expected under identical exposure conditions.

10. Auxiliary Reactor Area (ARA)

a. ARA Facilities

The ARA[45] (shown in Figure II-2) is located east of the SPERT area and consists of four subareas, ARA-I, -II, -III, and -IV, where U. S. Army portable power reactors were tested until approximately 1965. All reactors have been removed or dismantled. The existing buildings now are used as test facilities, office space, a metallurgy laboratory, instrument development laboratory, and a hot cell. The hot cell is a shielded facility for the remote handling and preparation of radioactive test specimens.

The ARA-I area is part of the area originally occupied by SL-1, an Army operated reactor destroyed by a nuclear excursion in 1961 (described in Section II.C.11). The original Army reactor support buildings and some additions which were constructed later are presently used for a metallurgy laboratory and a hot cell.

The ARA-II was originally occupied by the SL-1. After the SL-1 accident, the area was decontaminated and now consists of three office buildings which are occupied by PBF personnel. In addition, the area contains a water well and treatment plant for supplying water to the ARA-I and ARA-II.

The ARA-III was built originally to house the Army Gas Cooled Reactor Experiment (GCRE). The facility, along with two newer buildings, is now used for laboratory and office space.

The ARA-IV was designed to house the Mobile Low Power Plant No. 1 (ML-1) reactor, a portable gas-cooled water-moderated power reactor designed for the Army. The Fast Transient Reactor (FRAN) was installed later in the main test building, but has since been removed from the area. The facilities at the ARA-IV include a control building and liquid and gaseous waste disposal systems. At the present time, this facility is idle.

b. Systems for Venting Radioacitve and Nonradioactive Airborne Waste

The only source of radioactive gases from any of the ARA facilities is the ARA-I hot cell, which exhausts air through stacks. A stack monitor system utilizes four separate detectors to maintain constant surveillance of the exhaust system. The system is checked continuously for iodine and for particulate, alpha, and gaseous activities. The hot cells are equipped with roughing filters, absolute filters (one cell also has charcoal filters), and blowers, all of which maintain negative pressure on the cells and exhaust air through the stack. The air from the two individual cells is drawn through roughing filters inside the cells and HEPA filter banks before being discharged through two separate stacks. In 1974 ARA did not release any detectable quantities of airborne radioactivity.

The sources of nonradioactive chemical airborne waste are exhaust gases from boilers and building ventilation and small gasoline driven motors. These sources are all checked periodically by industrial hygiene personnel to assure that the effluents are maintained within the applicable air pollution standards.

c. Systems for Disposal of Radioactive Liquid Wastes

A small amount of radioactive liquid waste is generated at ARA-I by operations at the hot cell and metallurgy facilities. This waste is collected in a 1,000-gallon-capacity waste holding tank. No radioactive materials presently exist at ARA-II; however, there is a 1,000-gallon-capacity waste holding tank to serve the area. No radioactive liquid waste is generated at ARA-III at the present time. When the GCRE was operating, large quantities of liquid waste containing very low levels of contamination, were normally generated. Because of the limited capacity of the low-level liquid waste storage tank, a gravity system was installed to allow transfer of material from this tank to a seepage pond west of the GCRE facility. This modification involved the installation of several hundred feet of 6-in. concrete pipe along the north side of the test building. The radioactive liquid waste system at the ARA-IV consists of a 10,000-gallon capacity stainless steel holding tank buried at the corner of the test site and a seepage pond.

All liquid radioactive waste generated at the ARA-I is collected in the waste holding tank, sampled, and sent to ICPP for processing. This was also the procedure for the ARA-II when the reactor was operating. When the GCRE was operating at the ARA-III, procedures were established which specified that the liquid waste in the storage tank be monitored prior to release to the seepage pond and that the pond be monitored periodically to prevent buildup of contamination. No problems were experienced with this system throughout the program. Waste storage capacity of the ARA-IV is sufficient to hold more than the amount of waste that could be generated by the plant at any one time. Wastes were disposed of either by draining to the seepage ponds (if allowable under radioactivity regulations) or by transfer from the holding tank to ICPP for processing.

d. Systems for Disposal of Nonradioactive Liquid Wastes

The ARA sanitary waste system is made up of several separate septic tank systems which serve the areas and buildings as described below:

(1) The ARA-I has an 800-gallon septic tank with a 500-gallon holding tank and provisions for chlorination prior to discharge to the seepage pond

(2) The ARA-II has a 1,000-gallon septic tank with provisions for chlorination prior to discharge to a seepage pond

(3) The ARA-III has a 1,000-gallon septic tank with a 420-ft by 4-in. drain field and a 3,000-gallon septic tank with discharge to a drain field

(4) The ARA-IV has two 1,000-gallon septic tanks with provisions for chlorination prior to discharge to seepage pits.

e. Systems for Disposal of Radioactive and Nonradioactive Solid Wastes

A small amount of solid radioactive waste is generated at the ARA-I by the metallurgy laboratory and the hot cells when they are operating. The waste is packaged to prevent spread of contamination and transported to the INEL Radioactive Waste Management Complex. In 1974 ARA generated 1.0 ft^3 of solid radioactive waste containing 9 μCi of radioactivity.

All ARA facilities generate some routine nonradioactive office and shop solid waste. This is placed in suitable containers and handled by dumpsters for transfer to the CFA sanitary landfill.

11. Low Power Test (LPT) and Experimental Beryllium Oxide Reactor (EBOR)

a. History of the Complex

The Low Power Test (LPT) and the Experimental Beryllium Oxide Reactor (EBOR) facilities complex[45] is located at TAN (see Figure II-2), approximately 1-1/4 miles south-southeast of the TSF complex, and is one of three satellite facilities at TAN. Although the LPT and EBOR are housed in separate buildings, they share common industrial and fire control water and a common sewage disposal system, but each facility has its own electrical distribution system and HV systems. Figure II-52 is a photograph of the complex taken in 1973.

These facilities were originally constructed for reactor testing activities during the ANP program. At that time EBOR was known as the Shield Test Pool Facility (STPF) and was later renamed when the facility was modified and expanded for the EBOR program. LPT was put into operation in 1958, and STPF was started up in 1959. With the exception of the addition of a storage room, LPT is essentially unchanged since its original construction, while EBOR has undergone extensive modification since its original construction. The LPT[a] facility currently supports LOFT nonnuclear Semiscale testing.

The two facilities share a common water source: a deep well, pump, and two water storage tanks having a combined capacity of 195,000 gallons. Although the water system has a chlorination facility, it is not normally used.

(1) The EBOR Facility Reactor

When originally constructed as STPF, the EBOR facility was composed of two adjacent buildings; one housed administration offices, utility areas, and a reactor control room, and the other was a large high bay building with an overhead crane and two deep pools. The south pool was equipped with bridgework which held a "swimming pool" type reactor designated as "SUSIE." This reactor was used as a radiation source of gamma rays and neutrons for performing experiments in nuclear powered aircraft shield designs. The reactor was a simple rectangular array of MTR-type clad fuel elements held in a grid plate near the bottom of the pool. Shielding experiments were performed at power levels less than 10 kW and natural circulation of water between the fuel plates in the reactor afforded sufficient cooling, with the heat merely being transferred to the pool water and eventually to the cement structural material and surrounding ground. The north pool was used as storage space for fuel elements and radioactive experimental equipment.

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[a] LPT recently designated the LOFT Technical Support Facility (LTSF).

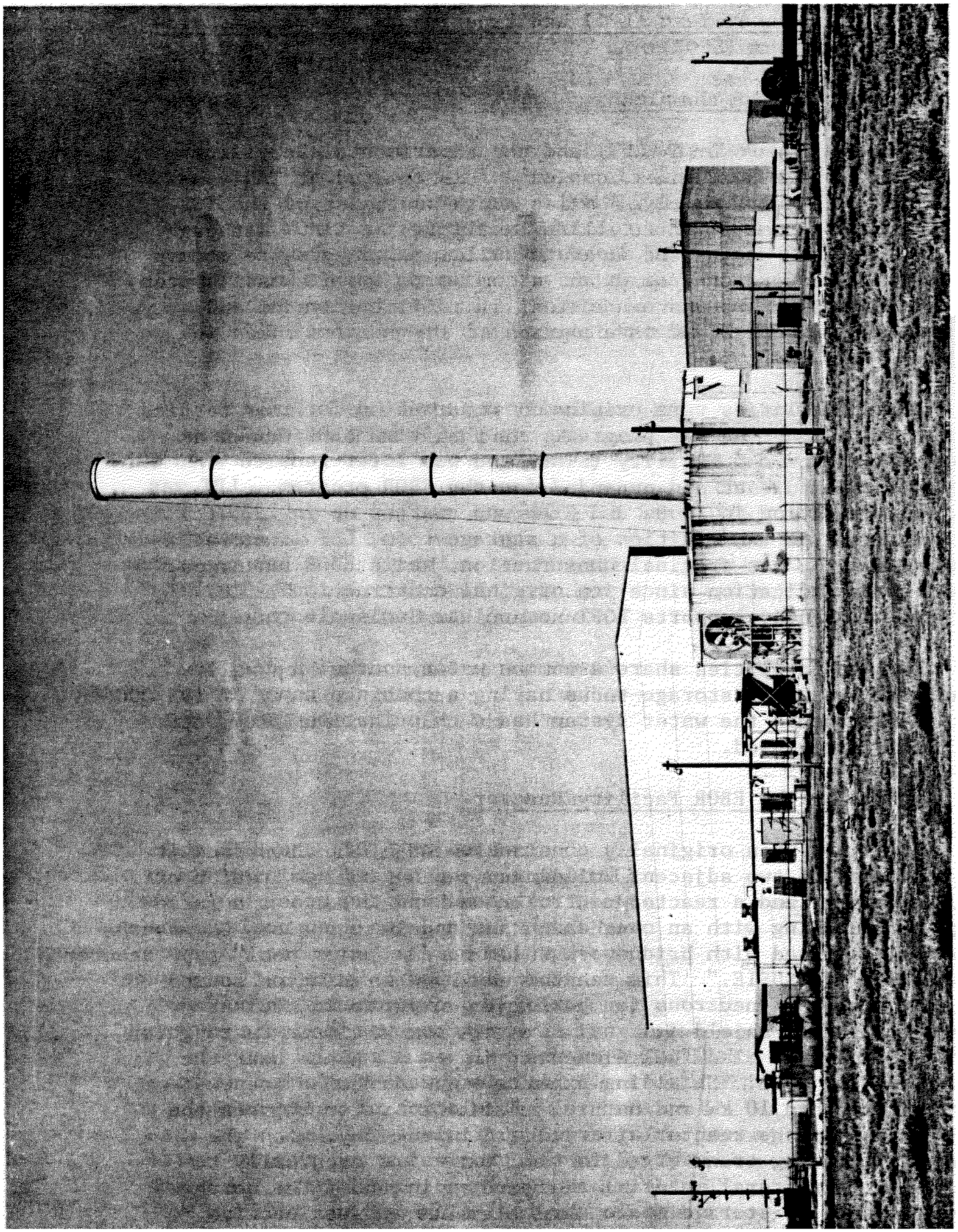

Figure II-52. LPT-EBOR Facility Complex.

At the termination of the ANP program in April 1961, the SUSIE reactor was modified by the addition of a metal shroud and some external piping so that, through the use of pumps and a heat exchanger, the pool water could be forced through the reactor. The reactor then was operated at 2 MW of power and was used as a radiation source for testing capsules of organic materials (oils) proposed for use as reactor coolant and moderators in large electric power producing reactors. The heat removed in the heat exchanger from the reactor coolant was dumped to a disposal well by the flow of industrial water through the shell side of the heat exchanger. The reactor was operated in this mode, as a materials test reactor, for approximately 1 year, after which it was dismantled and shipped to the Sandia Corporation at Albuquerque, New Mexico.

The facility modifications for the EBOR program were started in 1963 and completed in 1967. These modifications consisted of the addition of a facility for handling and cooling the reactor coolant and of deepening the south pool area to house and support the reactor vessel. Industrial water storage capacity was increased by the addition of another water storage tank.

The EBOR program, however, was terminated in 1966 before fuel was inserted into the reactor, and the facility subsequently has been used for nonnuclear testing programs. These programs have included tests for acoustical vessel fracture using the EBOR pressure vessel for developing liquid-metal sodium loop technology, for fluids testing, and for support of the thermal reactor safety program.

(2) <u>The LPT Facility</u>

The LPT facility is composed of two large concrete shielded cells[47] which house test reactors and an associated building with control rooms, office, and utilities equipment space. Normal occupancy has been from 5 to 10 people.

The facility has highly versatile capabilities for conducting experiments and obtaining reactor physics and engineering design data on engineering "mockups" of real or proposed reactor systems. These tests can be conducted at low or near zero power, and consequently no heat removal systems are required. During the ANP program, the facility was used for pretesting reactor cores in a specifically designed tank before these cores were transported to the Initial Engineering Test (IET) facility for high-power testing. It has been utilized subsequently for a number of specialized low-power tests.

Currently reactor operation at LPT is minimal, and the office area is being utilized by personnel engaged in nonnuclear testing at the EBOR facility.

b. Systems for Venting Radioactive and Nonradioactive Airborne Wastes

The HV system at the EBOR is divided into two subsystems. Those areas where radioactivity is expected to be present exhaust through a duct system, fan, prefilters, absolute HEPA-type filters, an iodine removal filter, to a 126-ft-high stack. The stack effluent is monitored. The HV subsystem is intact and operable, but no airborne radioactive material has ever been generated at EBOR and the system is not presently being used.

Two potential sources of airborne radioactivity exist at the LPT. One of these sources is two specially made steel hoods, located in a fuel handling room, which are used to prevent spread of contamination from handling of uranium foils used in experiments. Handling of bare or uncoated uranium foils can result in release of small quantities of radioactive airborne particles. The hoods exhaust through a roughing filter and an absolute HEPA filter, then through a duct with a fan to the atmosphere. The operating condition of the absolute filters is checked annually.

The other source of airborne radioactivity generated at the LPT results from the operation of certain types of reactor experiments using unclad (uncovered) uranium fuel. Fission products resulting from fissions occurring at or near the surface of the uranium fuel sheets (foils) are free to escape into the test cell volume. This is especially true of those fission products which consist of gaseous atomic elements such as iodine and the noble gases xenon and krypton. Most of these airborne radioactive materials are contained within the test cell volume until they decay (within a few hours) to stable nonradioactive isotopes.

The only nonradioactive discharges to the atmosphere at the LPT and EBOR are from the HV systems which exhaust through roof ventilators. These are continuously operating, automatically controlled forced-air systems for heating and ventilating the buildings.

c. Systems for Disposal of Radioactive Liquid Wastes

Prior to the EBOR modification, the STPF generated no radioactive liquid wastes. The pools were equipped with a cleanup system filter which removed radioactive material from the pool water, and the filters were shipped to the INEL Radioactive Waste Management Complex and disposed of as solid waste. The low-level radioactivity in these filters came from neutron activation products of trace mineral impurities in the pool water which circulated through the reactor. With one exception, no liquid radioactive wastes have been generated at the facility after the EBOR modifications. This exception was an accidental release (described in Section II.C.11) of contaminated water from a pump which had been installed for a special test. The pump had been used previously in other reactor experiments and had been decontaminated for its use at the EBOR. However, a misunderstanding over how the pump was to be plumbed into the system led to a hookup which allowed circulation through a pump housing coolant loop that had not been decontaminated. This resulted in contamination of an industrial water line and a discharge of radioactivity to a disposal pond of about 50 mCi of cobalt-60 activity.

Radioactive liquid wastes at the LPT are collected in a tank from floor drains in the reactor test cells and from personnel showers and hand washbasins located adjacent to the restrooms. This 3,000-gallon tank is buried 9 ft below grade. The tank is equipped with a pumpout fitting, a stick gauge, and high- and low-liquid-level alarms which actuate inside the LPT control rooms. Normal procedure calls for pumping the contents of the tank, if they are above the limits for discharge to the environment, into a tanker truck for transport to the TSF or ICPP radioactive liquid waste process plants; otherwise, the waste is pumped directly to a disposal pond. Each tankful of waste is sampled and analyzed, enabling a decision on the mode of disposal. There are nominally two tanks of waste per year generated at the LPT. None of the liquid accumulated has been above the limits set for disposal to the environment, and except for the incident mentioned above, there has been no recorded discharge of radioactivity to the disposal pond.

d. Systems for Disposal of Nonradioactive Liquid Wastes

Industrial water from both EBOR and LPT is normally collected from various floor drains and piped directly to a disposal well. Chemical content is low and consists mainly of the residues from operation of the demineralizer. The demineralizer at the EBOR is intact but not in service, and has not been used for approximately 10 years. The acid regeneration backwash for this large water treatment system drains to an acid neutralizing pit before discharge to the disposal well.

A small water treatment plant was installed at the LPT in 1966 to supply demineralized water to the facility steam boilers as a means of reducing heating system pipe corrosion. Backwash from this small system drains directly to the disposal well through the LPT floor drain system. The LPT demineralizer also furnishes small amounts of treated water to EBOR experiments at the present time.

Sanitary wastes flow through the EBOR and LPT sewer system to a septic tank located to the south of these buildings. Effluent from the septic tank is treated chemically, passed through a sand filter, and discharged to the disposal well. The chemical treatment consists of adding calcium hypochlorite through a chemical mixing tank. The sand filter bed has a volume of 735 ft^3, and the septic tank is a 5,600-gallon unit with a design capacity of 6,000 gallons/day.

The EBOR-LPT complex occupancy is nominally 10 people and has been fairly constant for the past 10 years.

As noted above, both industrial and sanitary wastes are discharged to the environment via a disposal well. This 315-ft-deep well is located to the south of the EBOR-LPT complex. It has a 10-in.-diameter perforated black steel casing. The well depth to water is nominally 209 ft.

e. Systems for Disposal of Radioactive and Nonradioactive Solid Wastes

All solid radioactive wastes at the EBOR-LPT complex are low-level wastes such as filters, rags, mops, paper, and other cleaning materials. These wastes are generated through cleanup of areas where radioactive materials (primarily high-enrichment uranium) are handled. The wastes are collected in cardboard boxes contained in metal waste receptacles for temporary storage until accumulation justifies transport to the INEL Radioactive Waste Management Complex. Most of the waste is generated at the LPT and, nominally, less than 300 ft^3 of loosely packed material is disposed of each year.

Before 1970, all nonradioactive solid wastes which were burnable were collected and transported to the TAN burn pit where periodic burning was initiated. Since 1970, however, all such waste is transported to the CFA sanitary landfill. With the exception of construction wastes, almost all nonradioactive wastes from the EBOR-LPT complex are routine office-type trash.

f. Systems for Disposal of Thermal Wastes

Thermal discharge from reactors operated at the LPT is minimal because the reactor operations never exceed 1 kW of power. The only thermal discharge from this facility is from normal building heat loss and that from operation of the building HV systems.

Although a cooling tower was constructed at the EBOR to provide closed-loop cooling for various equipment associated with the reactor, it has never been put into operation but is intact at the facility. The only thermal discharge from the EBOR is normal building heat loss and that from operation of the building HV systems.

12. <u>Idle Facilities</u>

Several facilities[45] at the INEL are either on a standby status or are permanently shut down. These facilities have no significant processing or service activities, and have no personnel permanently assigned. Brief descriptions of the facilities and their associated waste handling systems are given below. In addition, the current status of waste systems and, where available, summaries of waste effluent releases are also given.

a. Special Power Excursion Reactor Test (SPERT) Facilities

The SPERT project was established as part of the reactor safety program in 1954. The overall project was directed toward experimental and theoretical investigations of the kinetic behavior and safety of nuclear reactors. The SPERT site is located approximately 4 miles east-northeast of the CFA. The area contains the four SPERT reactor facilities and a control center. The general plan of the SPERT site is shown in Figure II-53. All four reactors were operated remotely from the Control Center Area, at the center for the SPERT operations. The four reactor areas are arranged in a semicircle of approximately 1/2-mile radius from the Control Center Area and at least 1/2 mile from each other. None of the SPERT reactors are operational at the present time. Figure II-54 shows the liquid waste disposal systems for all the SPERT areas. The PBF also is located in the SPERT area (described in Section II.A.6).

The SPERT reactors are all in a shutdown or dismantled condition, and the status of all waste systems does not present a significant hazard to personnel or to the environment. There is continuing Health Physics surveillance of the area to verify the desired control of remaining residual contamination. The solid waste generated is primarily a result of this surveillance program, and although insignificant in quantity, this waste is disposed of according to INEL waste handling procedures. There are no postulated occurrences that would have unacceptable adverse environmental effects. Background information on each SPERT reactor follows:

(1) SPERT-I[48]

This first of the SPERT reactors became operational in 1955 and was deactivated in 1964. Its primary purpose was to measure the extent and effect of reactor excursions to very-high-power levels over a very short period of time. The reactor also was used to run self-destruction tests in various reactor cores. (The specific environmental considerations of those tests are covered in Section II.C.10.) The facility consisted of a galvanized iron reactor building which housed the reactor and associated equipment and a galvanized iron service building. The reactor vessel was a 16-ft-high by 10-ft-diameter by 1/4-in.-thick carbon steel tank, the top of which is embedded in concrete and located at floor level of the reactor building. Radioactive liquid wastes generated in the

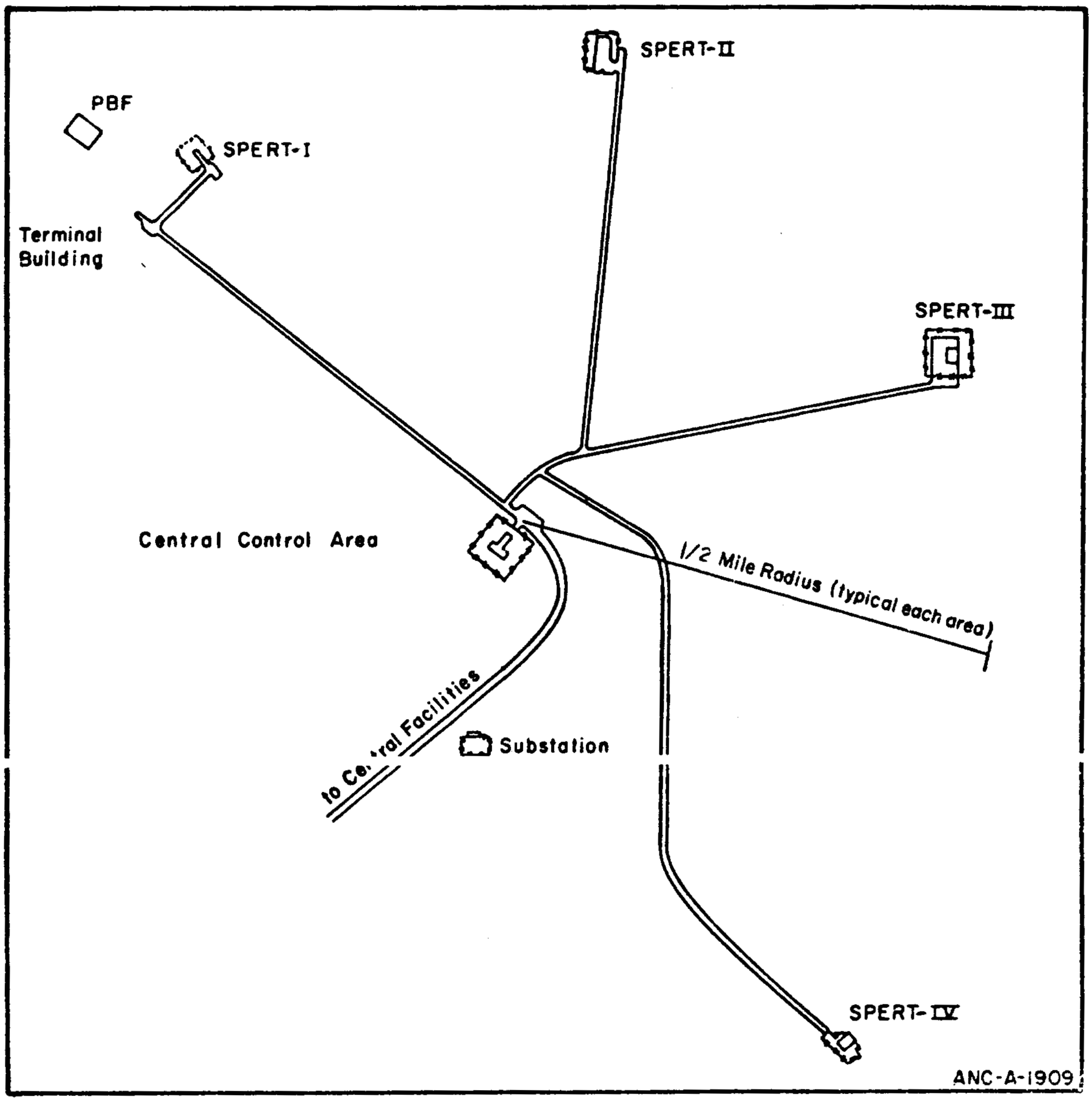

Figure II-53. General Plan of the SPERT Site.

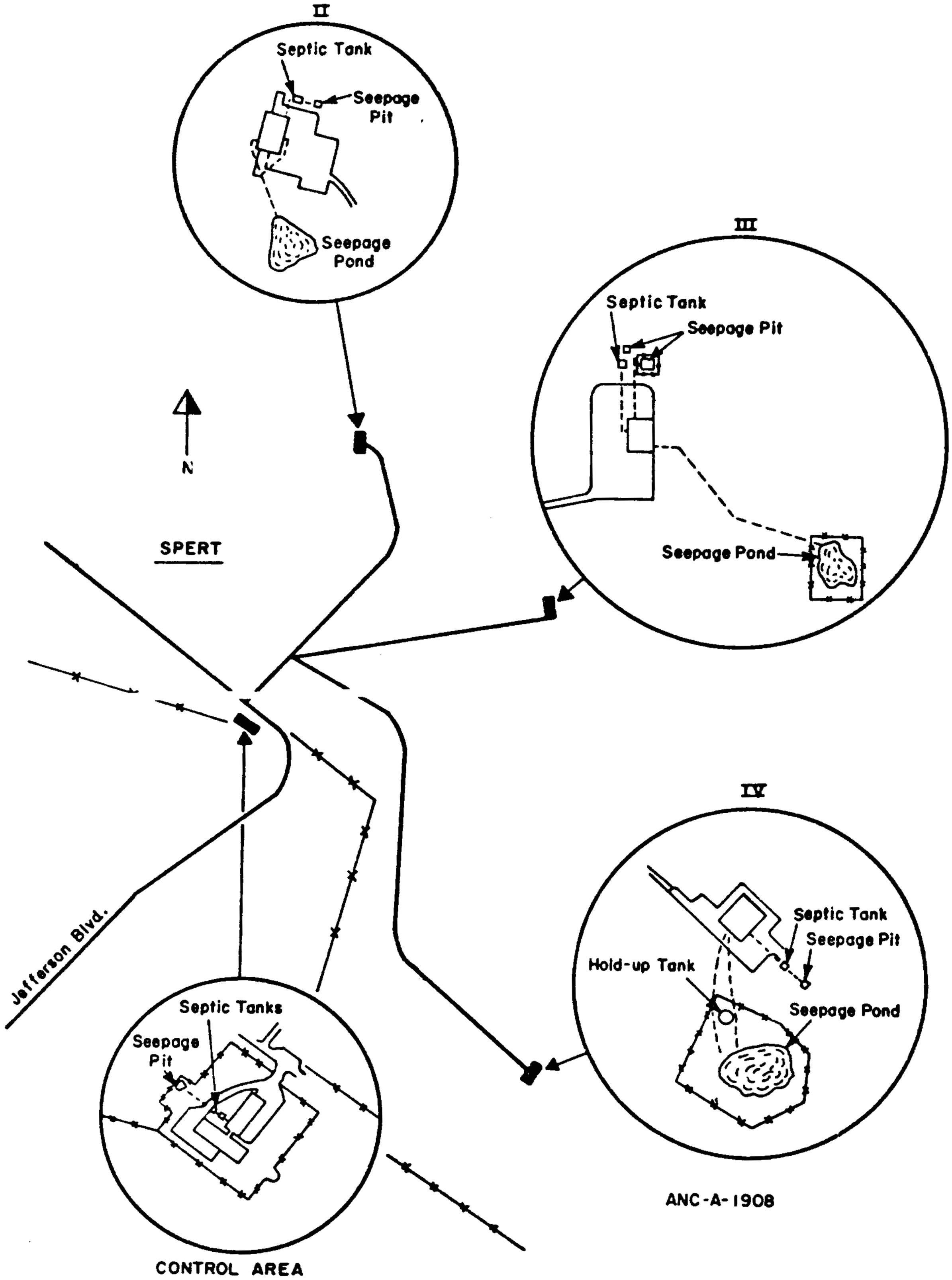

Figure II-54. SPERT Liquid Waste Disposal Systems.

reactor vessel were pumped as necessary to a 2,500-ft^3 seepage pond surrounded by an earth dike located 40 ft north of the reactor building. The reactor vessel remains and is partially filled with nonradioactive water. The dry contaminated seepage pond and several pieces of contaminated equipment still remain at the facility. Water treatment equipment originally pumped chemical wastes to a separate seepage pond, but the system is no longer functional. There was never a sanitary waste system at SPERT-I, and no wastes of any kind are presently being generated.

(2) SPERT-II[49]

The SPERT-II reactor became operational in 1960 and was placed on standby in 1964. The objectives of reactor experimentation were: to operate with either light or heavy water as moderator and coolant, to determine the transient characteristics of heavy-water-moderated reactors, to determine the parameters that affected these characteristics, and to determine the differences between light- and heavy-water-moderated reactors. The facility is now used primarily as a storage inspection point for PBF fuel. The reactor building consists of a main structure (housing the reactor and coolant systems) and a wing structure (housing electrical switchgear, process controls, instrumentation, and auxiliary equipment). During 1960 through 1964 operations, radioactive liquid wastes were pumped directly to a seepage pond located 300 ft south of the reactor, or were transported to the ICPP, depending upon the activity levels of the liquid wastes. All building floor drains, equipment drains, and primary system drains lead to the 10,000 ft^2 seepage pond. The pond is enclosed by a fence to prevent entry of unauthorized persons or large animals. Chemical wastes produced from water treatment were piped to a separate seepage pond. The sanitary system is still operable and sanitary wastes still are piped to a 625-gallon septic tank and to a 1,180-gallon (157-ft^3) seepage pit. Today, the reactor vessel is dry and contaminated with low levels of radioactivity. Several pieces of contaminated equipment remain in the area and are controlled by Health Physics procedures. The water treatment facilities also are shut down. Currently, minimal amounts of solid waste are generated as a result of the limited PBF activities being conducted at SPERT-II, which are transported as appropriate to either the INEL Radioactive Waste Management Complex or to the CFA sanitary landfill. One furnace is still operable and generates some sulfur dioxide and particulate matter.

(3) SPERT-III[50]

The SPERT-III reactor became operational in 1958 and was placed on standby status in 1968. The reactor was designed to determine the effect of water flow, pressure, and temperature on the transient characteristics of the reactor. The facility consists of a main reactor building which houses the reactor and coolant systems, and a wing that houses auxiliary equipment and instrumentation. The major source of radioactive liquid waste was low activity coolant water which was discharged directly to a 10,000-ft^3 seepage pond located outside the reactor building. Other liquid wastes were pumped to an 8,000-gallon underground holding tank where they were (a) allowed to decay to acceptable seepage pond limits, (b) concentrated by evaporation of the water, or (c) concentrated and then shipped to ICPP for additional treatment and storage. Chemical wastes from the water treatment equipment were piped to a separate seepage pond. Sanitary wastes were channeled to a 625-gallon septic tank or a 1,180-gallon (157-ft^3) seepage pit. Presently the reactor vessel is empty and the seepage pond is dry and slightly contaminated. The underground storage tank contains approximately 1,200 gallons of liquid. The last sample analysis indicated no detectable gamma nuclides and trace quantities of gross beta and alpha contaminants. However some contaminated equipment remains in the area. No radioactive liquid wastes and minimal nonradioactive solid wastes are presently generated at SPERT-III.

(4) SPERT-IV[51]

The SPERT-IV reactor became operational in 1961 and was placed on standby status in 1970. Radioactive liquid waste from the facility was collected in a monitored sump and then pumped either to a 60,000 gallon underground holding tank or to a seepage pond. Liquid collected in the holding tank was allowed to decay to levels that would permit pumping to the pond or transportation to ICPP for further treatment and storage. Chemical wastes from the water treatment equipment also were diverted to the same seepage pond. Uncontaminated waste cooling water was routed to a 6-million-gallon seepage pond. Sanitary wastes were channeled to a 1,000-gallon septic tank or to a 3,000-gallon (401-ft^3) seepage pit. Currently, the reactor vessel and the waste holding tank are empty and the seepage pond is dry. Several pieces of contaminated equipment remain at the facility. There are essentially no wastes being generated at SPERT-IV at the present time.

b. Organic Moderated Reactor Experiment (OMRE)

The OMRE[52] facility is located approximately 2-1/2 mi east of the CFA and occupies an area of about 132,000 ft^2. The OMRE was designed to investigate the feasibility of applying the concept of organic cooling to power reactors. The reactor became operational in 1958 and operated at a maximum thermal power level of 16.2 MW. The facility was shut down in 1963 at the termination of the organic program. The reactor is located outside the operations building under a corrugated sheet-steel shed. Most of the reactor vessel is buried underground. The main off-gas stream from the reactor was vented through a 16-in.-diameter metal stack, 37 ft above floor level.

The thermal and radiation damaged constituents from the organic coolant were purified by a vacuum distillation process, with the waste solution being collected in 55-gallon drums and disposed of as solid radioactive waste. The relatively small quantities of other radioactive aqueous or chemical wastes were discharged to a small seepage pond. Nonradioactive waste water was discharged directly to a drain ditch. Sanitary wastes were channeled to two septic tanks. Reactor fuel and organic coolant have been removed; all systems have been drained and deactivated. No solid, airborne, or liquid wastes are being generated, and no material is being stored at the facility. Contaminated piping and other material, as well as the dry contaminated seepage pond, still remain at the facility. The area is under a routine Health Physics monitoring program to assure containment of the residual radioactivity.

c. Experimental Organic Cooled Reactor (EOCR)

The EOCR[53] was in the final stages of construction in 1962 when the organic program was terminated. Although radioactivity was never introduced into the facility, some of the utility and sanitary waste systems were being operated at the time of deactivation. The EOCR was an organic-cooled and -moderated test reactor designed to operate at a thermal power level of about 40 MW. The EOCR is located approximately 2-1/2 mi east of the CFA and occupies about 2 acres. At the time of deactivation there were, in addition to construction workers, about 50 personnel at the facility; and the water treatment equipment and boilers were in operation for several weeks. Sanitary wastes were discharged to a septic tank and then to an oxidation pond, which was shared with the OMRE facility. Aqueous chemical wastes were discharged through a vitrified clay line to a 1.25-million-gallon-capacity seepage pond located approximately 400 ft north of the reactor building. The remaining aqueous waste streams were routed either directly to a disposal well or through settling tanks to the well. The disposal well extends approximately 400 ft into the ground. No radioactive solid, liquid, or airborne wastes were discharged at the EOCR, and only minimal amounts of nonradioactive wastes were generated. The entire facility is now inoperative. Much of the original equipment has been removed for use at other facilities and the existing structures and area also could be reused.

d. Initial Engineering Test Facility (IETF)

The IETF[45] is located in the northern part of the INEL, about 1 mile north of the TSF complex. It is a part of the TAN facilities and was originally constructed as the initial engine test area for the ANP program. The IETF project was discontinued in March 1961 when the ANP program was discontinued.

Later, the IETF was used in the SPERT "Safety Test Engineering Program" (STEP). This program involved engineering scale field testing to demonstrate the safety of aerospace and land based reactor systems. Tests of the SNAP No. 10-A were undertaken and designated SNAP Transit (SNAPTRAN) Nos. 1, 2, and 3. These programs were terminated in 1964, and since that time the IETF has not been in use and no personnel are assigned to the facility.

The facility consists of an underground control and equipment building and various other small service buildings. All utility systems at the facility are intact; however, only the fire protection and the electrical systems remain operable.

Radioactive liquid wastes generated at the IETF were moved by gravity to a 15,000-gallon underground waste holding tank. Depending upon the quantity and level of activity, the waste was transported either to ICPP for processing or pumped to the TAN liquid waste treatment plant.

Regeneration backwash from the water treatment equipment cooling water and other nonradioactive liquid wastes were discharged to a disposal well. The well is 324 ft deep. The sanitary sewer flows from the facility to a septic tank system south of the area. Effluent from the septic tank was chemically treated by hypochlorination, passed through a sand filter, and discharged to the disposal well. The septic tank is a 2,800-gallon unit with a design capacity of 2,000 gallons/day.

An exhaust system is associated with the test cell building, where the reactor tests took place. This system includes an exhaust duct from the test cell building to a 150-ft-high stack located approximately 200 ft north of the test cell building area.

Presently, no solid, liquid, or airborne wastes are being generated at the IETF. Some internally contaminated ICPP product bottles are stored within the facility, and the underground liquid storage tank is empty but slightly contaminated. The facility is under a routine Health Physics surveillance program.

e. Experimental Breeder Reactor-I[54]

EBR-I, located approximately 3 miles southwest of the CFA, was operated by the ANL-W. Construction began in October 1949 with initial startup and full-power operation achieved in 1951. The EBR-I is confined entirely within a single building constructed of steel, concrete, and brick. The building has two additions: a fuel storage facility, and an annex that contained offices for technical and administrative personnel.

EBR-I was unmoderated, and used sodium-potassium as coolant and enriched uranium as fuel. It operated with four different core loadings at a maximum power level of approximately 1 MW. The reactor heat transfer systems consisted of a primary closed-loop sodium-potassium stream system that removed the reactor heat and a secondary sodium-potassium loop that extracted heat from the primary system. Heat from the secondary system was converted to steam which was directed to the turbine or through a fan-cooled load dissipator.

The facility design was such that areas of high radioactivity potential were at a negative pressure with respect to areas of low potential. Exhaust air then was drawn from the building through a bank of filters and discharged out the stack. Although the radioactive airborne effluent was monitored constantly, no discharge data are available. The building heating system consisted of an oil-fired burner. Although specific characteristics of the effluent are not available, during 1963 and 1964, the EBR-I, BORAX, and ZPR-III sites combined burned 132,080 gallons of fuel oil and discharged 13,803 lb of sulfur dioxide to the atmosphere.

The reactor produced no radioactive aqueous waste. Industrial liquid wastes were discharged to a drainage ditch. Sanitary wastes were discharged first to a 1,000-gallon septic tank and then to a sanitary seepage pit. Specific quantities and characteristics of radioactive and nonradioactive solid wastes generated at EBR-I are not available. These wastes were sent to the RWMC and sanitary landfill respectively.

The reactor was decommissioned in 1964 after demonstrating successfully that a nuclear reactor, designed to operate in the high-energy neutron range, is capable of breeding (creating more fuel than its operation consumes).

On August 26, 1966, the EBR-I was officially designated as a registered National Historic Landmark. The facility is presently open to the public. Five thousand gallons of contaminated sodium-potassium coolant that had been stored in a vessel at EBR-I was reacted with water to form a stable caustic solution which was evaporated to dryness. The vessel was then sealed and placed in the Subsurface Disposal Area at the RWMC. The remaining building complex underwent extensive health physics monitoring before opening the complex to the public.

f. Boiling Water Reactor Experiment (Borax) Facilities

Early in 1953 the ANL began intensive research on the boiling water reactors. In these reactors the coolant moderator boils in the core and passes saturated steam direct to a turbine for power generation. This effort was referred to as the "Boiling Reactor Experiment," and five different reactors were operated and designated as BORAX-I, -II, -III, -IV, and -V. All were constructed and operated near the EBR-I facility, which is located approximately 3 miles southwest of the CFA.

(1) BORAX-I through -V

BORAX-I was constructed in 1953 and was destroyed during experimental tests in July 1954 to determine its inherent safety under extreme conditions. Appendix B contains the details of this destruct test.

BORAX-II was constructed in late 1954 for further tests, and new core combinations were tried using varying enrichments of uranium-235 in the metal fuel plates. The power level was 6 MW(t).

BORAX-III[55] was designed for a 15-MW(t) power level and was operated in 1955. This reactor was coupled to a 2,000-kW turbine generator to investigate use of boiling water reactors for generating electrical power. On July 17, 1955 it produced sufficient power to light the city of Arco, Idaho, population of approximately 1,500, for about 2 hrs.

BORAX-IV[56] was operated from December 1956 until June 1958. This 20-MW(t) reactor was used principally to test high-thermal-capacity fuel elements made from mixed oxides (ceramics) of uranium and thorium.

BORAX-V, with a design power of 40 MW(t), provided an extremely flexible facility for determining the safety aspects and feasibility of an integral nuclear superheat system. Initial operation was in 1962; superheated (dry) steam was produced wholly by nuclear means for the first time, and the reactor was shut down in September 1964.

(2) <u>BORAX Waste Systems</u>

The maturity and adequacy of the waste handling systems for BORAX-I-V increased as the programs developed. The systems stressed personnel safety and were based on the remoteness of location relative to disposal of airborne and liquid wastes and on the requirements for long-lived radioactivity decay. Since the duration of individual reactor tests was relatively short, the resulting fission product buildup inventory was kept at manageable levels, and disposal requirements were satisfied by dilution in water and atmospheric dispersion (no longer an acceptable practice). Very little information is available on the characteristics of the waste effluent streams, and the data that are recorded are generalized in conjunction with the effluents from the EBR-I and ZPR-III operations.

Radioactive airborne effluent at BORAX-V was routed through particulate HEPA filters and charcoal beds for iodine removal prior to discharge out the stack. In addition, the stream was monitored continuously. Airborne discharges from the other reactors, when occurring, went directly to the atmosphere. Nonradioactive effluent was discharged directly to the atmosphere.

Liquid wastes from BORAX-I and -II were directed to a sloped area remotely located on the desert floor. BORAX-III, -IV, and -V used ion-exchange columns for purification of the water used in the steam system liquid effluent. Nonradioactive liquid wastes from all the reactors were discharged to a seepage pond located several hundred feet away. The EBR-I sanitary system was used for all BORAX facilities, but a separate septic tank and drain field were added for BORAX-V.

Solid radioactive wastes from all the BORAX reactors were transported to the INEL Radioactive Waste Management Complex. Nonradioactive wastes either were burned or disposed of in other locations.

g. Zero Power Reactor No. 3 (ZPR-III)

The ZPR-III was a split-table machine in which criticality was achieved by bringing two halves of a fuel configuration together. It was used for determining the accuracy of predicted critical mass geometries and to determine critical measurements in connection with various loadings for makeup of fast reactor core designs. The reactor was located inside the EBR-I exclusion fence and was housed in a concrete building. The facility was first operated in 1955 and was placed on standby status in November 1970.

Radioactive airborne effluent was routed through particulate filters and discharged through a 25-ft-high stack mounted on the roof. Nonradioactive airborne effluent from the oil-fired space heaters was discharged directly to the atmosphere. No radioactive or industrial liquid wastes were produced in this facility. The sanitary waste effluent was discharged through a cast-iron pipe to a septic tank and seepage pond. Solid radioactive wastes were packaged and transported to the INEL Radioactive Waste Management Complex. Combustible nonradioactive solid waste was incinerated, and the noncombustible materials were stored for future disposition. As was previously mentioned, the very limited data available on the characterization of the waste effluents were generalized in conjunction with the effluents from EBR-I and BORAX operations. The ZPR-III releases consisted of fission product noble gases; actual measurements were not recorded, but a release of 0.3 Ci/yr (1955-1970) is conservatively estimated.

13. Decontamination and Decommissioning of INEL Facilities

Since the INEL has been in existence, many buildings and facilities have fulfilled their purposes, and additional programs for which they have been used are past; consequently the buildings and facilities have been left in various stages of completion, use, or nonuse.

Several of these INEL facilities are radioactively contaminated and are in one stage or another of deactivation. Each of the deactivated facilities at the INEL meets the guidelines listed in WASH-1202(74)[3] in that efforts have been made for facility reuse; radiation hazards have been reduced to the degree practical; surveillance and maintenance continues; and the public is restricted from access.

In addition to the efforts of the ERDA and its contractor to find some use for these deactivated facilities, the Eastern Idaho Nuclear Industrial Council compiled information and published a report in February of 1970 entitled "Potentially Available Facilities at the National Reactor Testing Station." The information compiled included factual information, photographs, drawing, and area maps. This report has been made available to potential government and private industry users.

A program is underway to formulate decontamination and decommissioning (D&D) and to carry out plans to dispose of the retired facilities and equipment in the safest and most cost-effective manner.

Details of the overall D&D program are given in the INEL Waste Management Plan[4] and are only summarized here. Basically, the program consists of the following elements:

(a) Identification of radioactively contaminated facilities and adjoining land

(b) Description of radioactive contamination

(c) Identification of funded projects

(d) Other radioactive materials

a. Identification of Radioactively Contaminated Facilities Adjoining Land

All INEL facilities were identified and categorized as either:

(1) Excess to present needs

(2) Excess within five years

(3) Currently standby

(4) Currently in use.

The first category is for those facilities considered to be in excess of present or projected needs at INEL and includes those facilities which have been retired from accountability.

The second category includes those facilities which, on the basis of the assumptions used in preparation of the FY-1975 budget, will not be needed beyond five years. Although its actual status may be either "in use" or "in standby," the facility has not yet been advertised as excess.

The third category is for those facilities that are in a standby status awaiting potential reuse. This category includes only those facilities for which an official determination as to standby has been made and recorded.

The last category includes those facilities which are presently being used. Many of these will ultimately require decontamination and decommissioning unless other expedient uses can be found.

b. Description of Radioactive Contamination

Each of the facilities on the inventory listing are surveyed to determine the nature and level of radioactive contamination present. Realizing that any description of contamination probably would involve mixtures or variations of all types, each facility is categorized in terms of fission products, induced activity, or transuranics.

On the basis of the radiological surveys, the facilities are placed in one of four activity level groups. These groups are defined by the relative amounts of time, manpower, chemicals, and expenditures of money necessary to decontaminate the facility to satisfactory levels.

c. Identification of Funded Projects

The amounts of $325,000 and $460,000 were funded respectively in FY-1974 and FY-1975 for disposal of liquid metal and decontamination and decommissioning in order to prepare the EBR-I as a National Historical Monument. The work was accomplished in FY-1975. ZPR-III was decontaminated and reconditioned for use as office and warehousing space by ANC. The D&D of these facilities will provide some practical information on problems to be encountered in future reactor facility decommissioning. The budget for FY-1975 included $460,000 for completing the D&D at the ZPR-III and EBR-I, $100,000 for D&D of the MTR working reservoir, and $100,000 for a study of INEL facilities needing D&D to develop a priority list. The D&D of the MTR working reservoir was completed for $5,000 in FY-1976.

d. Other Radioactive Materials

A final part of the D&D program plan includes consideration of miscellaneous pieces of equipment, piping, and reactor components that are contaminated and no longer in use. Also included are abandoned settling basins, drain fields, wells, septic systems, etc. These systems and associated pieces of equipment are all described in Section II.A. of this statement. Finally, the D&D plan also includes a discussion of residual contaminated grounds remaining from the accidental and programmatic radiological releases which have occurred over the lifetime of the INEL site and which are described in some detail in Section II.C.11.

As the necessary funds are made available, the latest technology will be utilized to effect an orderly D&D program in accordance with the priority list developed and mentioned above.

B. ANTICIPATED BENEFITS OF THE INEL WASTE MANAGEMENT PROGRAM

The anticipated benefits related to ongoing work at the INEL and its associated waste management operations can best be divided into three areas:

(1) benefits derived from operating waste facilities and maintaining a viable waste management program

(2) local sociological and economic benefits

(3) benefits to society from research and development.

The major benefit from INEL waste management programs is that each waste effluent stream from nuclear facilities is controlled to provide public protection and to minimize the impact these waste materials would otherwise have upon the environment. Waste systems have been included in facility and overall site designs throughout the INEL history. Over the years of INEL operations, waste treatment systems generally have been improved greatly as technology has advanced. For environmental and personnel protection, waste systems for currently operating facilities have been upgraded, and new facilities are being designed with extensive waste handling features.

Historically, exhaust air from most of the INEL nuclear plants was processed through filters prior to discharge to the atmosphere. Newer systems now are providing HEPA filters in series with absorbing media for the removal of radioiodines. In some cases, systems are also available for the removal of noble gases. Routine low-level radioactive solid waste now is being compacted to minimize the area committed for radioactive waste disposal. Solid transuranic waste is being confined by packaging this waste in polyethylene liners within sealed barrels, then stacking the barrels on an asphalt pad and covering them with plywood, plastic, and soil. This storage allows for retrieval and future shipment of these wastes to a Federal repository.

The research in waste management at the INEL, which is potentially applicable to prospective industry wastes, includes development of the first U.S. high-level radioactive waste solidification process. This process has allowed conversion of high-level radioactive acidic liquid wastes to a less mobile, solid form, which represents a distinct reduction in environmental hazard. The solidified wastes are stored near the surface in stainless steel bins inside concrete vaults and can be retrieved pneumatically. Nearly 2.8 million gallons of stored liquid waste (over half the total which has been generated) have been converted to solid material, with about a ninefold reduction in volume. The risk of environmental contamination is significantly reduced by conversion of the liquid wastes to a solid form.

The sociological and economic benefits to the local community result mainly from employment availability, social stability, and monetary infusion into the regional economy. The economy of the surrounding area is predominantly agricultural, and the small business support from the INEL operation stabilizes the small business and industrial segment of the economy. INEL purchases in southeastern Idaho were in excess of $4 million during FY 1973, and the overall program funding for the INEL is near $100 million.

The benefits to society as a whole from the INEL research and development program and other associated functions are many and varied. The INEL has made extensive contributions to the naval reactors program, the liquid-metal fast breeder reactor program, the light-water reactor program, the fuel reprocessing program, the Army reactor program, and the organic reactor program. These contributions have ranged from component and subsystem development to major plant demonstration programs. Major benefits have been derived from the light-water reactor safety program in the areas of investigation and development of materials, instrumentation, analytical codes, physics, and engineering. These contributions have provided a broad base for the development and safe operation of commercial nuclear facilities in meeting the present energy demands. Further, benefits have been derived in the field of biomedicine in the areas of dosimetry, environmental surveillance, radioecology, geochemistry, and microseismicity. Benefits to society also have been derived in the chemical field through the development of the world's first high-level radioactive waste solidification process, major development in reducing radioactive effluents from plant operations, development of fluidized bed technology for solidification and combustion operations, control of nuclear materials through the use of soluble neutron poisons, and the adoption of a fluid bed calcination process for purification of saline waters.